Master's Programme in Engineering Physics Study Guide 2015-2016

For the reader

This study guide explains the degree requirements of the programmes, and gives students the necessary information about completing the degree and its contents.

In addition to study guides, Aalto University uses various online services for planning and monitoring one's studies, and for keeping up with what is going on at the university. In planning one's studies, this study guide and the online tools complement each other and should be used side by side.

Below is an introduction to students' most important online tools:

Degree Structure

Minor

All students in the Master's Programme in Engineering Physics may have a minor as part of their studies. In Engineering Physics major, the student can choose to complete a minor subject instead of completing a more extended major. For the students having Physics of Advanced Materials as their major, a minor can be completed as part of the elective studies. Students can choose a minor from Aalto University's offerings, other Finnish universities or universities abroad. The student is advised to discuss the matters with the professor in charge or other faculty. The minor is confirmed in the Personal Study Plan.

More information on Aalto University's minor subjects:

- Aalto University Minors Guide 2015-2016

Elective studies

Students choose 25-30 ECTS of elective studies. As elective studies, students can complete a minor and/or take individual courses from other programmes at Aalto University or other Finnish universities. Students can also participate in an international student exchange programme or do an internship in Finland or abroad (max. 5 cr). The elective studies can also contain a minor.

For more information on internationalisation or Aalto University's minor subjects:

- Aalto University Minors Guide 2015-2016
- Internationalisation and studies abroad

Language studies

Compulsory language studies for students whose language of education is Finnish or Swedish are included as part of the bachelor's degree. If the language studies have not been completed in the phase preceding master's studies, they must be taken during the master's degree studies. In this case, the student must take 2 ECTS in second national language and demonstrate both oral (o) and written (w) proficiency in one foreign language (3 ECTS) in order to fulfil language proficiency requirements.

Students who have received their education in a language other than Finnish or Swedish or received their education abroad are required to complete only 3 ECTS in one foreign language (including both oral (o) and written (w) proficiency).

Students with excellent command of English (e.g. English as a first language) may apply for the exemption from the compulsory foreign language requirement and take 3 ECTS of Finnish courses instead. In this case, according to the Degree Regulations, the student has not demonstrated the requisite written and oral language requirement in a foreign language, which is reflected in the appendix of the degree certificate. Students may apply for an exemption in the beginning of each

term (deadlines 15 September and 15 January) with an application form available in Into at https://into.aalto.fi/display/enmastersci/Forms.

The language studies are included in student's elective studies.

More information about language courses can be found on the Language Centre's website into.aalto.fi/display/enlc/.

Master's thesis

Students are required to complete a master's thesis, which is a research assignment with a workload corresponding to 30 credits. The thesis is written on a topic usually related to the student's major, or in some special cases to the minor, and agreed upon between the student and a professor who specializes in the topic of the thesis. The supervisor of the thesis must be a professor in the University, whereas the thesis advisor(s) must have at least a master's degree.

Master's thesis work includes a seminar presentation or equivalent presentation. The student is also required to write a maturity essay related to the master's thesis.

The master's thesis is a public document and cannot be concealed.

Graduation

Students can apply for the master's degree after completing the bachelor's degree, when all courses required for the master's degree have been completed and the master's thesis is evaluated and approved by the Degree Programme Committee. The Dean grants the degrees.

Master's degree awarded with distinction

Students who have demonstrated excellent knowledge of their field in their studies, and particular maturity and sense of judgment in the master's thesis may be awarded a diploma for the degree of Master of Science (Technology) with distinction. The decision on awarding a degree with distinction rests with the Dean of the School of Science.

A degree may be awarded with distinction if the weighted grade average of the courses included in the degree, excluding the master's thesis and the grade of the master's thesis are at least 4.0. Courses graded 'pass' or 'fail' shall not be included in the calculation.

Majors

Master's Programme in Engineering Physics offers two majors from which students can choose: Engineering Physics and Physics of Advanced Materials.

The extent of the major is 40-65 ECTS depending on the major. In Engineering Physics major, the student can choose to complete the major either as a compact major (40 ECTS) or as a long major (65 ECTS). If the student chooses to complete Physics of Advanced Materials major, the extent of the major is always 65 ECTS.

The major is confirmed in the Personal Study Plan in the beginning of studie

Engineering Physics

Professor in charge: Mikko Alava
Extent: 40-65 cr
Abbreviation: EngPhys
Code: SCI3056

Objectives

The objective of the major is to give the student the chance of profiling the studies for the future professional life while providing a very strong background in physics and mathematics. The studies include a lot of hands-on experience with research. Many of the students continue with a career in research, first with PhD studies.

Content and structure

The Engineering Physics major consists of two parts: a core content and a flexible choice of courses selected by the student. The core courses of the major cover important topics for engineering physics, and methods from computational, theoretical, and experimental physics. The core content includes also some choices for more detailed focusing on a certain subject. The rest of the studies have a very flexible structure, and provide the student with the possibility of focusing in physics, nanoscience, energy studies, or designing a more cross-disciplinary content for the major. The student can also choose to complete a minor subject, or complete a more extended major.

The core idea is to maintain the rigorous training while giving a possibility for the student to tune the contents. This rigor is a main strength, traditionally, of the program, both for doctoral studies and as regards its “brand name” on the job market.

The contents are: one mathematics, applied mathematics, or systems analysis course (5 cr), a choice between the Advanced Physics Laboratory or Computational Physics (5 cr), a Special Assignment (research or literature study, 10 cr), and 4 courses from the structure (together 40 cr). To complete an extended major, the student selects also elective physics or other relevant courses so that the extent of the major is 65 cr. All the courses listed in the table below are acceptable. If the student wishes to include other courses to the extended major than the courses listed below, the student is advised to agree on the courses with the professor in charge.

In the case of a 40 cr major the student is recommended to take 30 cr of the major courses and 30 cr of others during the first year. The special assignment can also be completed during the summer between the first and second year in the programme.

CODE	NAME	CREDITS	PERIOD	YEAR
PHYS-E0411	Advanced Physics Laboratory	5	III-V	1.
OR				
PHYS-E0412	Computational Physics	5	III-V	1.

PHYS-E0441	Physics Special Assignment V	10		2.
OR				
PHYS-E0481	Advanced Energy Technologies, special assignment V	10		2.
MS-Exxxx	One mathematics, applied mathematics or systems analysis course*	5		1.
Select four courses from the selection below:				
PHYS-E0413	Theoretical Mechanics	5	I-II	1.
PHYS-E0414	Advanced Quantum Mechanics	5	I-II	1.
PHYS-E0415	Statistical Mechanics	5	I-II	1.
PHYS-E0421	Solid-State Physics	5	IV-V	1.
PHYS-E0422	Soft Condensed Matter Physics	5	III-IV	1.
PHYS-E0435	Optical Physics	5	I-II	1.
PHYS-E0460	Reaktorifysiikan perusteet	5	I-II	1.

* The mathematics courses on the MSc level include: MS-E1651 Numerical matrix computations, MS-E1652 Computational methods for differential equations, MS-E1653 Finite element method, MS-E1654 Computational inverse problems, MS-E2139 Nonlinear programming, MS-E1740 Continuum mechanics I, MS-E1600 Probability theory.

Physics of Advanced Materials

Professor in charge: Mikko Alava
Extent: 65 cr
Abbreviation: PAM
Code: SCI3057

Objectives

In the major the students concentrate on materials in the wide sense. The academic environment provides a spectrum of contacts with top-notch research into advanced materials. The students are expected to focus either on experimental or theoretical and computational physics. The major is intended both for research-oriented students and for those who are particularly interested in advanced materials.

Content and structure

Students majoring in Physics of Advanced Material face a similar structure for the major as those majoring in Engineering Physics: compulsory course content with some choice and a wide selection of additional courses.

The Physics of Advanced Materials major is comprised of 1) core major studies (40 cr); 2) an extended major (25 cr) where the student chooses either a theoretical/computational or experimental track, reflecting her/his research interests.

The student is recommended to take 40 cr of the major courses and 20 cr of others during the first year. The special assignment can also be completed during the summer between the first and second year in the programme.

PHYS-E0441	Physics Special Assignment V	10		2.
OR				
PHYS-E0481	Advanced Energy Technologies, special assignment V	10		2.
PHYS-E0411	Advanced Physics Laboratory	5	III-V	1.
	OR			
PHYS-E0412	Computational Physics	5	III-V	1.
Select five courses from the selection below:				
PHYS-E0411	Advanced Physics Laboratory	5	III-V	1.
PHYS-E0412	Computational Physics	5	III-V	1.
PHYS-E0413	Theoretical Mechanics	5	I-II	1.
PHYS-E0414	Advanced Quantum Mechanics	5	I-II	1.
PHYS-E0415	Statistical Mechanics	5	I-II	1.
PHYS-E0421	Solid-State Physics	5	IV-V	1.
PHYS-E0422	Soft Condensed Matter Physics	5	III-IV	1.
PHYS-E0423	Surface Physics	5	III-IV	1.
PHYS-E0424	Nanophysics	5	I-II	1.
PHYS-E0435	Optical Physics	5	I-II	1.
PHYS-E0483	Advances in New Energy Technologies	5	III-IV	1.

To complete an extended major, the student chooses 25 cr of courses either from theoretical/computational track or from experimental track.

THEORETICAL/COMPUTATIONAL TRACK: SELECT 25 CR FROM THE SELECTION BELOW

CODE	NAME	CREDITS	PERIOD
PHYS-E0413	Theoretical Mechanics	5	I-II
PHYS-E0416	Quantum Physics	5	III-IV
PHYS-E0436	Modern Optics	5	IV-V
PHYS-E0441	Physics Special Assignment	10	

PHYS-E0551	Low Temperature Physics	5-6	
PHYS-E0525	Microscopy of Nanomaterials	5	III-IV
KE-31.4120	Computational Methods of Physical Chemistry	4	II
ELEC-E3230	Nanotechnology	5	IV
MS-E1654	Computational inverse problems	4-6	IV
MS-E1651	Numerical matrix computations	5	I

EXPERIMENTAL TRACK: SELECT 25 CR FROM THE SELECTION BELOW

CODE	NAME	CREDITS	PERIOD
PHYS-E0417	Experimental Methods in Physics	5	I-II
PHYS-E0416	Quantum Physics	5	III-IV
PHYS-E0436	Modern Optics	5	IV-V
PHYS-E0437	Laser Physics	5	IV-V
PHYS-E0441	Physics Special Assignment	10	
PHYS-E0551	Low Temperature Physics	5-6	
PHYS-E0525	Microscopy of Nanomaterials	5	III-IV
PHYS-E0526	Microscopy of Nanomaterials, laboratory course	5	IV-V
ELEC-E3210	Optoelectronics	5	III
ELEC-E3230	Nanotechnology	5	IV
ELEC-E3280	Micronova Laboratory Course	5	I-II